We Claim:

1. An apparatus for detecting the presence of flame in the exhaust path of a gas turbine engine comprising:

an optical viewing port capable of being mounted to the gas turbine engine exhaust section to collect the radiant energy present in the exhaust path;

a sensor element that is sensitive to the radiant energy produced from flame transmitted from said optical viewing port, wherein said sensor element emits an electrical signal when radiant energy is present; and,

an output means connected to said sensor element activated when flame has been detected in the exhaust path of the gas turbine causing the electrical signal.

2. The apparatus for detecting the presence of flame in the exhaust path of a gas turbine engine of claim 1 further comprising:

a fiber optic cable assembly mounted to receive the radiant energy from said optical viewing port;

an electro-optics module that restricts the spectral energy to wavelengths specific to the signatures of the flame source from a wavelength of 200 nm to 800 nm.

3. The apparatus for detecting the presence of flame in the exhaust path of a gas turbine engine of claim 1 further comprising:

a computer to receive said output and make a determination of the state of the fuel nozzle clog.

4. The apparatus for detecting the presence of flame in the exhaust path of a gas turbine engine of claim 1 further comprising:

a storage device capable of saving said electrical signal from said sensor element for later analysis.

5. The apparatus for detecting the presence of flame in the exhaust path of a gas turbine engine of claim 1 further comprising:

a fiber optic cable assembly mounted to receive the radiant energy from said optical viewing port;

a collection optics to receive the radiant energy from said fiber optic cable and efficiently couple the radiant energy to said sensor element.

6. An apparatus for determining the condition of the fuel nozzle of a gas turbine comprising:

an optical viewing port capable of being mounted to the gas turbine engine to collect the radiant energy from the exhaust path;

a fiber optic cable assembly mounted to receive the radiant energy from said optical viewing port;

an electro-optics module configured to receive the radiant energy from the fiber optic cable and indicate when flame has been detected in the exhaust path of the gas turbine.

7. A method of determining the state of the fuel nozzle of a gas turbine comprising the steps of:

receiving radiant energy from the exhaust path of a gas turbine;

transferring the radiant energy to at least one sensor capable of detecting radiant energy; and,

indicating when radiant energy within the range has been received from the exhaust path.

8. The method of determining the state of the fuel nozzle of a gas turbine of claim 7 further comprising the steps of:

amplifying the radiant energy from the exhaust path of the gas turbine.

9. The method of determining the state of the fuel nozzle of a gas turbine of claim 7 further comprising the steps of:

filtering the radiant energy to a wavelength of about 200 to 800 nm.

10. A method of determining the state of the fuel nozzle of a gas turbine comprising the steps of:

receiving radiant energy from the exhaust path of a gas turbine;

transferring the radiant energy to at least one sensor capable detecting radiant energy produced from a flame presence in the exhaust;

determining the average of the baseline of the normal background intensity of the radiant energy of a gas turbine known to be operating efficiently with clean fuel nozzles;

producing a signal from at least one of the sensors when the radiant energy in the 200 nm to 800 nm range has been received from the exhaust path;

comparing the output of the sensor to the known baseline;

signaling the presence of flame when the signal produced has a relative intensity greater than that of the average baseline intensity.

11. The method of determining the state of the fuel nozzle of a gas turbine of claim 10 further comprising the steps of:

storing the baseline and signal produced from a sensor that indicated the presence of a flame in the exhaust.

12. The method of determining the state of the fuel nozzle of a gas turbine of claim 10 further comprising the steps of:

measuring the duration of time that the relative intensity of the signal produced is greater than the baseline;

indicating to the operator of the gas turbine if the duration of time exceeds 30 ms.

13. The method of determining the state of the fuel nozzle of a gas turbine of claim 10 further comprising the steps of:

measuring the intensity of the signal produced from the sensor;

indicating to the operator of the gas turbine if the sensor output reaches a level greater than the average relative intensity of the baseline by a predetermined amount based on the level of turbine activity.

14. A method of detecting the presence of flame in the exhaust of a turbine comprising the steps of:

gathering a light energy by the view port attached to the exhaust plenum;

transmitting said light energy by a fiber optic cable into a spectrometer through a fixed aperture;

striking light energy against a collimating mirror;

directing said light energy at a diffraction grating;

refracting light by a grating;

directing toward a focusing mirror;

reflecting diffracted light to strike onto a focusing mirror;

focusing onto a detector array;

.concentrating light In front of the detector array with a lens onto an individual detectors;

responding to the individual wavelength of light that strikes a detector element (pixel) with an electrical signal;

feeding said signals into a microprocessor;

interpreting a signal strength and information relative to the intensity of the individual wavelengths of light as received by said detector array and,

providing information to end user of the gas turbine.

15. The method of claim 14 further comprising the steps of:

limiting the effects of second and third order wavelength harmonics using an order sorting filter.

16. The method of claim 14 further comprising the steps of:

determining the spectral nature of the flame condition being monitored.

17. The method of determining presence of flame in the exhaust of a gas turbine comprising the steps of:

collecting spectral energy from the exhaust portion of a gas turbine;

transmitting said spectral energy to a spectrometer optics comprising a chopper, at least one prism that serves as a disperser, and parabolic optical-path-folding mirrors;

projecting spectrally dispersed light onto an array of photodetectors;

controlling the chopper, synchronizing readout from the pixels with the chopping cycle, and sending data to an external computer or data logger with electronic circuitry, at the repetition frequency of at least 390 Hz.

18. The method of claim 17 wherein said photodetector is lead selenide based.

19. The method of determining presence of flame in the exhaust of a gas turbine comprising the steps of:

collecting spectral energy from the exhaust portion of a gas turbine;

transmitting said spectral energy to a sensor;

producing an electrical signal corresponding to the intensity and presence of a flame in the exhaust;

storing the electrical signal in a storage device.

20. The method of determining presence of flame in the exhaust of a gas turbine of claim 19 further comprising the steps of:

providing a computer processor to evaluate the electrical signal.

21. The method of determining presence of flame in the exhaust of a gas turbine of claim 20 further comprising the steps of:

performing with the computer processor operations comprising:

establishing a threshold level

$$T_i = \frac{1}{\alpha} \sum_{n=i+1}^{\alpha+i} \sqrt{X_n^2} + NT \Bigg|_{i=0}^{\infty}$$

wherein α = running average interval, n = discrete sample number, *NT* = noise threshold;

determining a sample intensity value

$$SI_i = \frac{1}{\alpha} \sum_{n=i+1}^{\alpha+i} \sqrt{X_n^2} \Bigg|_{i=0}^{\infty}$$

wherein α = running average interval, n = discrete sample number;

freezing the threshold level until the sample intensity value gets below the threshold level;

establishing an ending point of the flash interval

$$B = SI_i > T_i \Big|_{i=0}^{\infty};$$

establishing a total integrated intensity value

$$E = SI_i < T_{frozen} \Big|_{i=0}^{\infty};$$

establishing a total time captured for the flash interval

$$I = \sum_{B}^{E} SI_i - T_{frozen} \Big|_{i=0}^{\infty}$$

$$C = \sum_{B}^{E} i \Big|_{i=0}^{\infty};$$

establishing a peak intensity value

$$P = SI_i \max \Big|_{i=0}^{\infty};$$

wherein the results of operations T_1, SI_1, B, E, I, C and P produced are stored in a memory device.

22. The method of determining presence of flame in the exhaust of a gas turbine of claim 21 further comprising the steps of:

comparing the stored results of operations T_1, SI_1, B, E, I, C and P;

determining that a condition requiring maintenance of the nozzles exists.

23. The method of determining presence of flame in the exhaust of a gas turbine of claim 22 further comprising the steps of:

indicating that a condition requiring maintenance of the turbine exists.